Tofting TF-100W

Ultrasonic Flowmeter

User Manual – Ver. 2.0

tech

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1 Introduction

1.1 Preface

Welcome to use new generation transit-time ultrasonic flowmeter, please read the user manual carefully before using. The wall-mount ultrasonic flowmeter is designed to be installed in a fixed location for long-term flow measurement.

1.2 Features

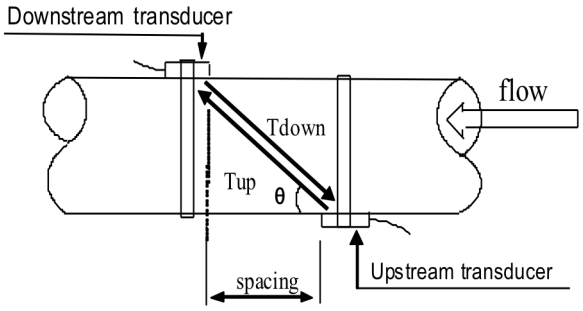
- ♦ Linearity: 0.5%, Repeatability: 0.2%, Accuracy: ±1%
- ♦ Easy to operate.
- ♦ Several type transducers for selection, measuring pipe size is from DN15mm to DN6000mm
- ♦ Adopt low voltage, multi-pulse technology to improve accuracy, useful life and reliability.
- ♦ Powerful Recording Function, record the totalizer data of the last 64 days/64 monthes/5 years.

1.3 Flow measurement principle

The TF-100W ultrasonic flowmeter is designed to measure the fluid velocity of liquid within a closed conduit. The transducers are a non-contacting, clamp-on type, which will provide benefits of non-fouling operation and easy installation.

The TF-100W transit-time flowmeter utilizes two transducers that function as both ultrasonic transmitters and receivers. The transducers are clamped on the outside of a closed pipe at a specific distance from each other. The transducers can be mounted in V-method where the sound transverses the pipe twice, or W-method where the sound transverses the pipe four times, or in Z-method where the transducers are mounted on opposite sides of the pipe and the sound crosses the pipe once. This selection of the mounting method depends on pipe and liquid characteristics. The flow meter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the transit time that it takes for sound to travel between the two transducers. The difference in the transit time measured is directly and exactly related to the velocity of the liquid in the pipe, show as follows:

$$V = \frac{MD}{\sin 2\theta} \times \frac{\Delta T}{T_{up} \bullet T_{down}}$$



Where:
θ is the include angle to the flow direction
M is the travel times of the ultrasonic beam
D is the pipe diameter
$\mathbf{T_{up}}$ is the time for the beam from upstream transducer to the downstream one
$\mathbf{T_{down}}$ is the time for the beam from downstream transducer to the upstream one
$\mathbf{\Delta T = T_{up} - T_{down}}$

1.4 Typical application

The wall-mounting flow meter can be applied to a wide range of pipe flow measurements. Applicable liquids include pure liquids as well as liquid with small quantity of tiny particles.

Examples are:
⋆ Water (hot water, chilled water, city water, sea water, waste water, etc.);
⋆ Sewage with small particle content;
⋆ Oil (crude oil, lubricating oil, diesel oil, fuel oil, etc.);
⋆ Chemicals (alcohol, acids, etc.);
⋆ Plant effluent;
⋆ Beverage, liquid food;
⋆ Ultra-pure liquids;
⋆ Solvents and other liquids

1.5 Product Identification

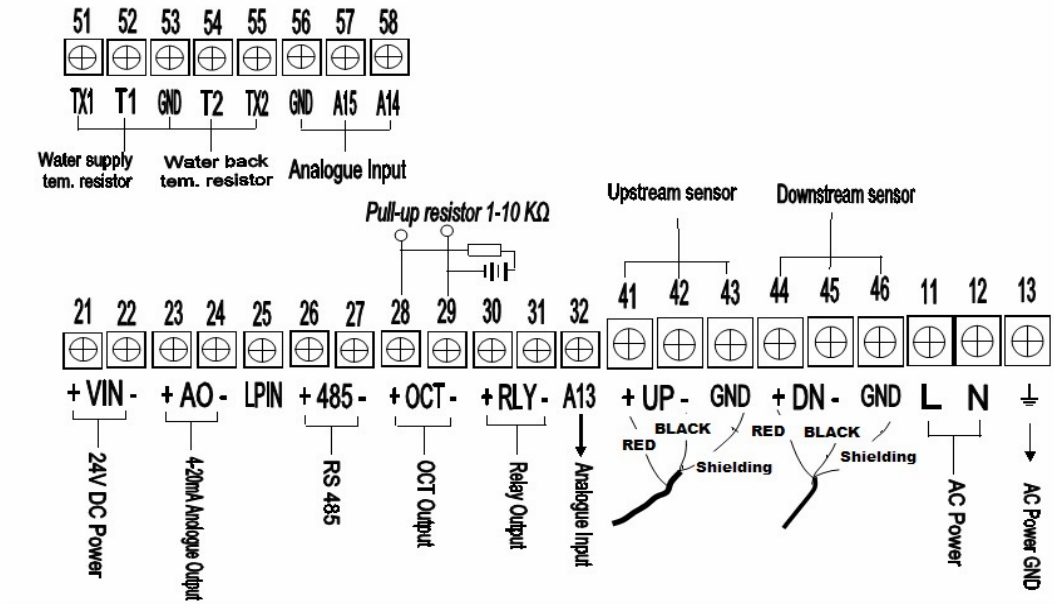
Each set of the flow meter has a unique product identification number or ESN (electronic serial number) written into the software that can only be modified with a special tool by the manufacturer. In case of any hardware failure, please provide this number which is located on menu window **M61** when contacting the manufacturer.

1.6 Specifications

Items		Specifications
Main unit	Accuracy	Better than ±1%
	Repeatability	Better than 0.2%
	Principle	Transit-time measuring principle
	Measurement Period	500ms
	Display	LCD with backlight, display accumulated flow/heat, instantaneous flow/heat, velocity, time etc.
	Output	Analogue output: 4-20mA or 0-20mA current output. Impedance 0~1kΩ. Accuracy 0.1%.
		OCT output: Frequency signal (1~9999HZ)
		Relay output: over 20 source signal (no signal, reverse flow etc.)
		RS485 serial port
	Input	Three analogue input
		Three-wire PT100 resistor input (optional)
	Other functions	Automatically record the totaliser data of the last 64 days / 64 months / 5 years; The power-on time and corresponding flow rate of the last 64 power on and off events. Allow manual or automatic flow loss compensation The instrument working status of the last 64 days
pipe	material	Steel, stainless steel, cast iron, cement pipe, copper, PVC, aluminum, FRP etc. Liner is allowed
	Size	15-6000mm
	Straight pipe section	In the upstream it must be beyond 10D, in the downstream it must be beyond 5D, in the upstream the length must be beyond 30D from the access of the pump. (D stands for pipe diameter)
Liquid	Types	Water, sea water, industrial sewage, acid & alkali liquid, alcohol, beer, all kinds of oils which can transmit ultrasonic single uniform liquid
	Temperature	Standard: -30˚C - 90˚C , High-temperature : -30˚C - 160˚C
	Turbidity	Less than 10000ppm, with a little bubble
	Flow Direction	Bi-directional measuring, net flow/heat measuring
Environment	Temperature	Main Unit: -30˚C…80˚C
		Transducer: -40˚C…110˚C, Temperature transducer: select on enquiry
	Humidity	Main Unit: 85% RH
		Transducer: water-immersible, water depth less than 3m
Cable	Twisted Pair Line, standard length of 20m, can be extended to 500m (not recommended); Contact the manufacturer for longer cable requirement. RS-485 interface, transmission distance up to 1000m	
Power Supply	AC220V or DC24V	
Power Consumption	Less than 1.5W	
Protocols	MODBUS, Fuji extended protocol and other factory protocol	

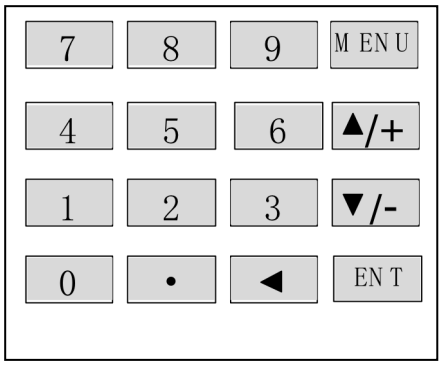
2 Installation and Measurement

2.1 Wiring diagram



2.2 Keypad

The keypad for the operation of the flow meter is as shown by the right picture.



- Keys [0] - [9] and [.] are keys to enter numbers
- Key [▲/+] is the going UP key, when the user wants to go to the upper menu window.
  It also works as the "+" key when entering numbers
- Key [▼/-] is the going DOWN key, when the user wants to go down-sided menu window.
  It also works as the "–" key when entering numbers.
- Key [◄] is backspace key, when the user wants go left or wants backspace the left character that is located to the left of the cursor.
- Key [ENT] is the ENTER key for any inputting or selections.
- Key [MENU] is the key for the direct menu window jump over. Whenever the user wants to proceed to a certain menu window, the user can press this key followed by 2-digit numbers.
- The [MENU] key is shortened as the 'M' key afterward when referring to the menu windows.
- The [ON] key is for the power on.
- The [OFF] key is for the power off.

2.3 Menu Windows

The user interface of this flow meter comprises about 100 different menu windows that are numbered by M00, M01, M02 … M99.

There are 2 methods to enter certain menu window:

1. Direct going/entering. The user can press the MENU key followed by two-digit number keys. For example, the menu window M11 is for the entering of pipe outer diameter. The display will go to the M11 menu window after the user presses MENU 1 1 .

2. Pressing ▲/+ and ▼/- keys. Each time of the ▲/+ key pressing will proceed to the lower-numbered menu window. For example, if the current window is on M12, the display will go to the number M11 window after pressing the ▲/+ key.

There are three different types of menu windows:

1. Menu windows for number entering, like M11 for the entering of pipe outer diameter.

2. Menu windows for option selection/selecting options, like M14 for the selection of pipe materials.

3. Displaying windows only, like M00 to display Velocity, Flow Rate etc.

For number entering windows, the user can directly press the starting digit key when the user is going to modify the value. For example, when the current window is on M11, and the user is going to enter 219.2345 as the pipe outer diameter, the user can get the numbers entered by pressing the following serial keys: 2 1 9 . 2 3 4 5 ENT.

For the option selection windows, the user should first press the ENT key to a selection modification mode and then select the relevant options by pressing the ▲/+ and ▼/- keys or the digit keys to select the option with a number antecedent to the option. In the end, the ENT key must be pressed to make the selection.

For example, with menu window M14 for the selection of pipe material selection, (the MENU 1 4 should be pressed first to enter this menu window if the current menu window is on a different window. The pipe material is stainless steel which has a number “1” antecedent to “stainless steel” on the display, the user should first press the ENT key to enter into a selection modification mode, then either make the selection by pressing the ▲/+ and ▼/- keys to make the cursor on the line that displays “1. Stainless Steel”, or make the selection by pressing the 1 key directly.

Generally, the ENT key must be pressed to enter a modification mode. If the “Locked M47 Open’ message is indicated on the lowest line of the LCD display, it means the modification operations is locked out. In such cases, the user should go to M47 to have the instrument unlocked first before any further modification can be made.

2.4 Steps to Configure the Parameters

The following parameters need to be configured for a proper measurement:

(1) Pipe outer diameter M11
(2) Pipe wall thickness M12
(3) Pipe materials M14 (for non-standard pipe materials*, the sound speed for the material must be configured too)
*Standard pipe materials and standard liquids refer to those with the sound parameters that have already been programmed into software of the flow meter, therefore there is no need to configure them
(4) Liner material and its sound speed and thickness, if there is any liner M16
(5) Liquid type (for non-standard liquids, the sound speed of the liquid is also needed) M20
(6) Transducer type adapted to the flow meter. Five types transducers/sensors in M23 **Please refer to 3.2 Menu Window Details.**
(6) Transducer mounting methods M24 (The V-method or Z-method is the common option)
(7) Check up the Space displayed on M25 and install the transducers accordingly
(8) Store the parameter setup M26

For standard pipe materials and liquids, the following step-by-step setup is recommended.

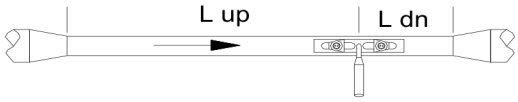
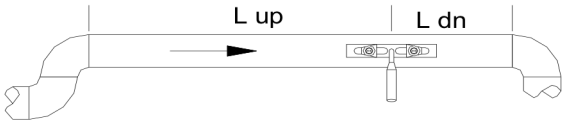
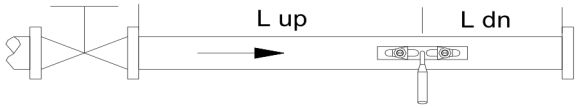
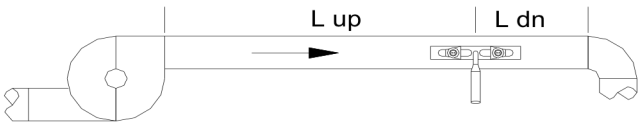
(1) Press keys [MENU] [1] [1] to enter M11 window to input the digits for the pipe outer diameter, and then press [ENT] key.
(2) Press key [▼/-] to enter M12 window to input the digits for the pipe outer diameter and then press [ENT] key.
(3) Press key [▼/-] to enter M14 window, and press [ENT] key to enter the option selection mode. Use keys [▲/+] and [▼/-] to scroll up and down to the intended pipe material, and then press [ENT] key.
(4) Press key [▼/-] to enter M16 window, press [ENT] key to enter the option selection mode, use keys [▲/+] and [▼/-] to scroll up and down to the liner material, and then press [ENT] key. Select “No Liner”, if there is no liner.
(5) Press key [▼/-] to enter M18 window, press [ENT] key to enter the liner thickness and then press [ENT] key (if there is liner)
(6) Press key [▼/-] to enter M20 window, press [ENT] key to enter the option selection mode, use keys [▲/+] and [▼/-] to scroll up and down to the proper liquid, and then press [ENT] key.
(7) Press key [▼/-] to enter M23 window, press [ENT] key to enter the option selection mode, use keys [▲/+] and [▼/-] to scroll up and down to the proper transducer type, and then press [ENT] key.
(8) Press key [▼/-] to enter M24 window, press [ENT] key to enter the option selection mode, use keys [▲/+] and [▼/-] to scroll up and down to the proper transducer mounting method, and then press [ENT] key.
(9) Press key [▼/-] to enter M25 window and check up the installation space.
(10) Press [MENU] [2] [6] to store the parameter setup (refer to M26)
(11) Press [MENU] [9] [0] to check up signal strength and quality, the bigger of the value the better. Generally the signal strength should be better than 60.0, and signal quality should be better than 50.0.
(12) Press [MENU] [9] [1] to check up time ratio, the ratio value should be in the range of 100±3%
(13) Press [MENU] [0] [8] to check up the working status, “R” means work well
(14) Press [MENU] [0] [1] to check up the measuring data.

Note:
1. For heat measurement, please connect PT100 which installed in water supply and water back pipe to T1, TX1, T2, TX2, GND terminal.
2. After setting parameter, remember to store parameter in MENU 26, to avoid parameter lose after turn off.

2.5 Transducers Mounting Allocation

The first step in the installation process is the selection of an optimum location in order to obtain a more accurate measurement. For this to be completed effectively, a basic knowledge about the piping and its plumbing system would be advisable.

An optimum location would be defined as a straight pipe length full of liquid that is to be measured. The piping can be in vertical or horizontal position. The following table shows:

Piping Configuration and Transducer Position	Upstream Dimension L up x Diameters	Downstream Dimension L dn x Diameters
	10D	5D
	10D	5D
	10D	5D
	12D	5D
	20D	5D
	20D	5D
	30D	5D

2.6 Transducers Installation

2.6.1 For Clamp-on transducer

Examples of optimum locations.

Principles to selection of an optimum location
Install the transducers on a longer length of the straight pipe. The longer the better, and make sure that the pipe is completely full of liquid.
Make sure that the temperature on the location does not exceed the range for the transducers. Generally speaking, the closer to the room temperature, the better.
Take the pipe fouling into consideration. Select a straight length of a relatively newer pipe. If the condition is not satisfying, consider the fouling thickness as part of the liner for a better result.

Some pipes have a kind of plastic liner, and between the outer pipe and the liner there may be a certain thickness difference that will prevent the ultrasonic waves from direct traveling. Such conditions will make the measurement very difficult. Whenever possible, try to avoid this kind of pipes. If impossible, try our plug-in transducers that are installed permanently on the pipe by drilling holes on the pipe while liquid is running inside.

The transducers used by the TF-100W series ultrasonic flow meter are made of piezoelectric crystals both for transmitting and receiving ultrasonic signals through the wall of liquid piping system. The measurement is realized by measuring the traveling time difference of the ultrasonic signals. Since the difference is very small, the spacing and the alignment of the transducers are critical factors to the accuracy of the measurement and the performance of the system. Meticulous care should be taken for the installation of the transducers.

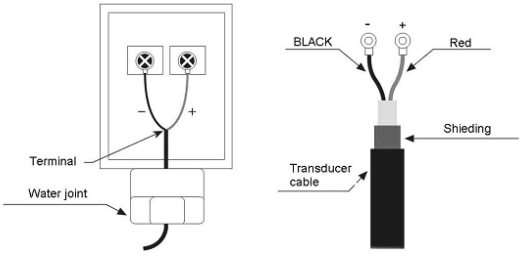
2.6.1.1 Steps to the installation of the transducers

Locate an optimum position where the straight pipe length is sufficient, and where pipes are in a favorable condition, e.g., newer pipes with no rust and ease of operation.
Clean any dust and rust. For a better result, polishing the pipe with a sander is strongly recommended.
Apply adequate coupling gel to the spot where the transducers are to be installed and leave no gap between the pipe surface and the transducers.

Extra care should be taken to avoid any sand or dust particles left between the pipe outer surface and the transducers.

To avoid gas bubbles inside the upper part of the pipe, the transducers should be installed horizontally by the side of the pipe.

2.6.1.2 Wiring diagram of transducer

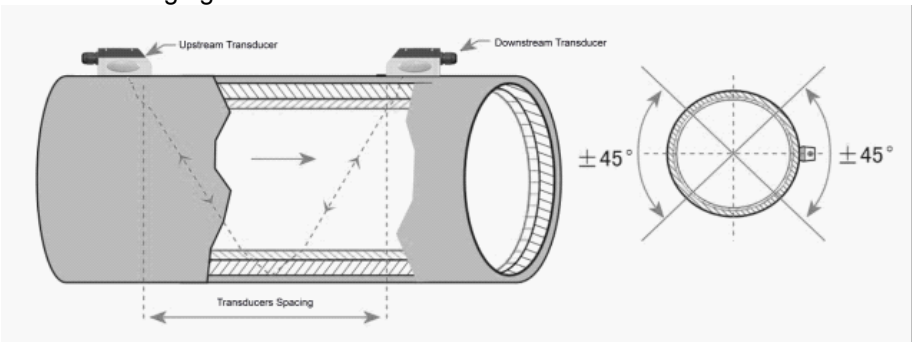


2.6.1.3 Transducers Spacing

The spacing value shown on menu window M25 refers to the distance of inner spacing between the two transducers. The actual transducers spacing should be as close as possible to the spacing value.

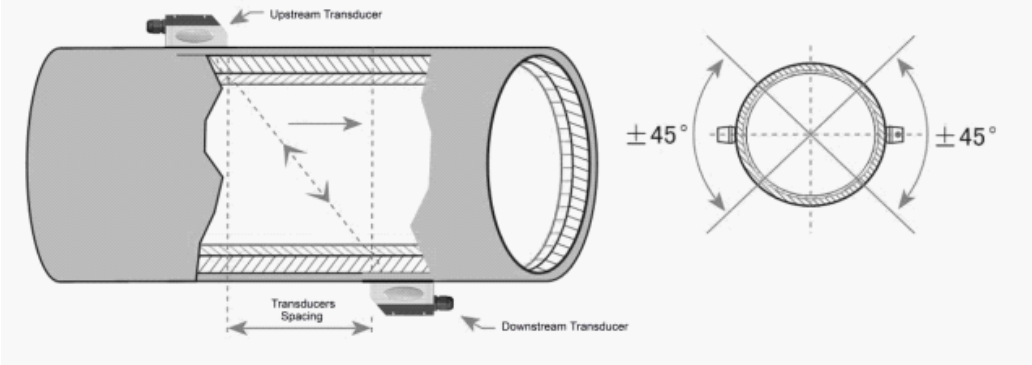
V-method Installation

V-method installation is the most widely mode for daily measurement with pipe inner diameters ranging from 15 mm to 200 mm. It is also called reflective mode.



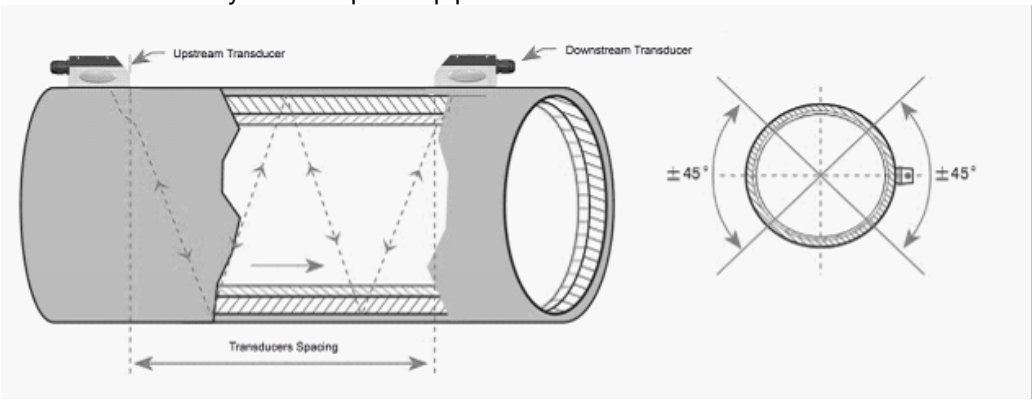
Z-method Installation

Z-method is commonly used when the pipe diameter is above 200mm.



W-method Installation

W-method is usually used on plastic pipes with a diameter from 15mm to 50mm.



N-method Installation

Rarely used method.

2.6.2 For Insertion transducer

2.6.2.1 Installation:

The new generation insertion type transducer combines the features of clamp-on and pipe transducer together, the details as follows:

High accuracy measuring: the sending crystal contact with the measure liquid directly, increase the accuracy and running stabilization of the flow meter.
Under pressure and non-stopping flowing, install the insert type transducer with the professional hole opener, therefore you can operate normally and also need not stop flow when maintaining.
Comparing with magnetic flow meter, it is much economic and accurate when measuring large size pipe.

2.6.2.2 Installation Tool

When you install the insertion type transducer, the hole opener, watt drill and wrench, screwdriver ect. tools should be prepared.

2.6.2.3 Installation space

Input the required parameter first, you will get the installation space in M25, install transducer depend on the installation space.

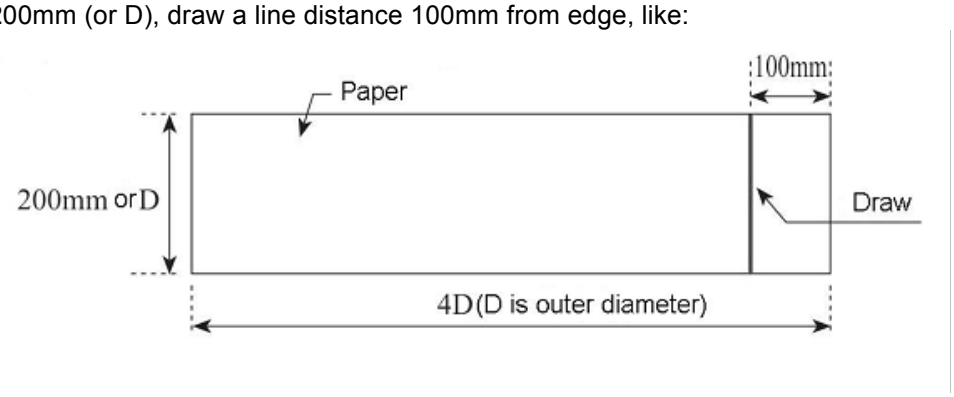
2.6.2.4 Installation method

There is only one type installation method with insertion type transducer, Z-method (over 80mm).

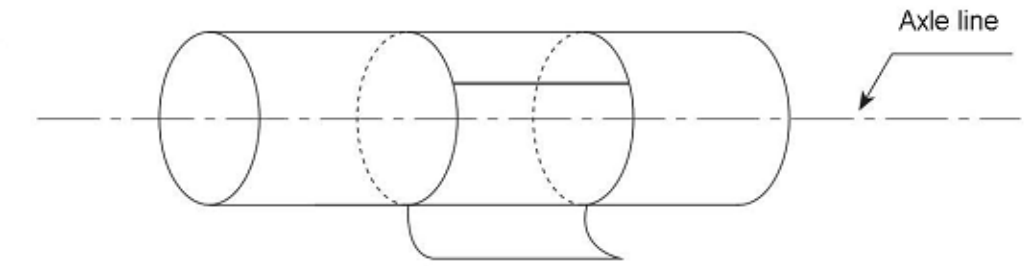
2.6.2.5 Installation steps

Input the parameter to get the installation space L (L = inner diameter-9.113mm), the installation space is the center distance between two transducer (keep the two sensor in the same section of axle).

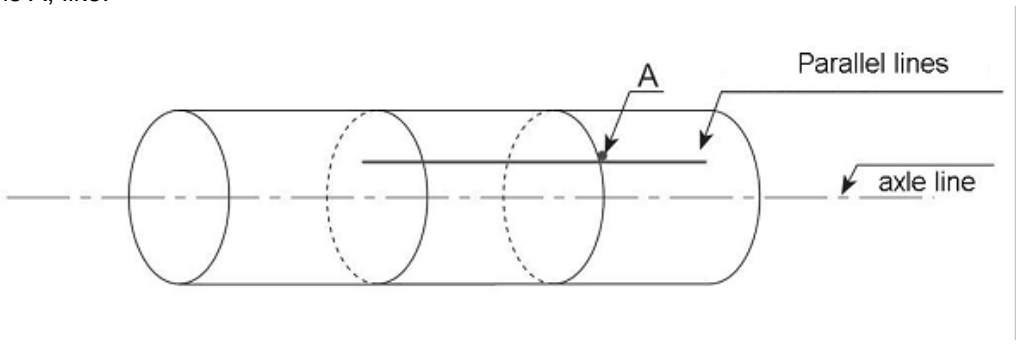
A. Setting position: take a piece of paper which length 4D (D is the diameter of pipe), width 200mm (or D), draw a line distance 100mm from edge, like:



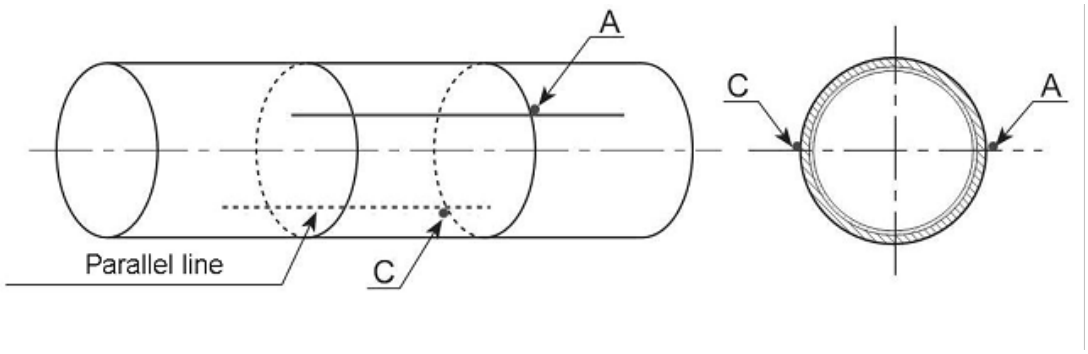
B. Wrap the paper on the cleaned surface of the pipe, keep the two edge overlap then the drawing line will keep parallel with the axle like:



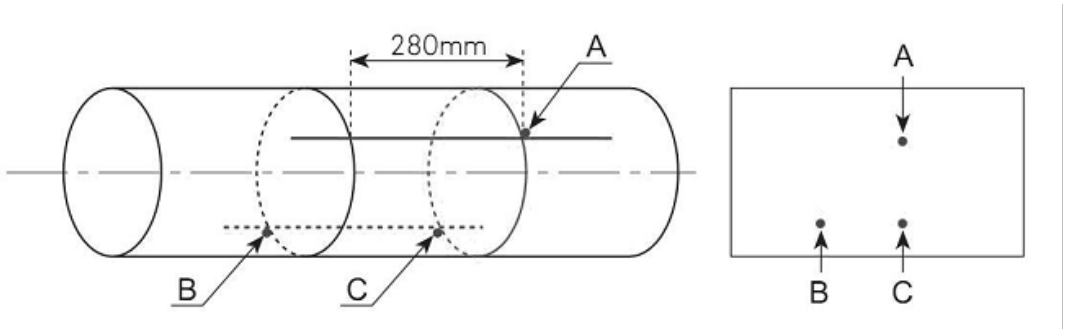
C. Extend the fitting paper line to the pipe, the node between drawing line and fitting paper edge is A, like:



D. From point A, measure out half of the perimeter from the position paper edge and this point is C, draw a line perpendicular from the edge of position paper like:

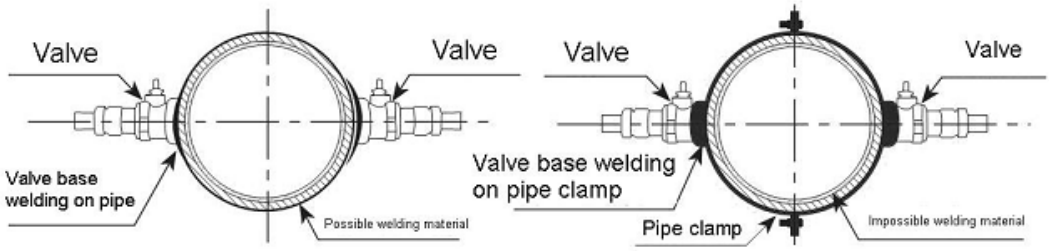


E. Get rid of the position paper, from point C measure the fitting distance L and get the point B than decide the fitting position of point A and B for example L = 280mm, Welding the valve outlet on point A and point B. Take notice that the center of valve must be overlap with point A and point B.



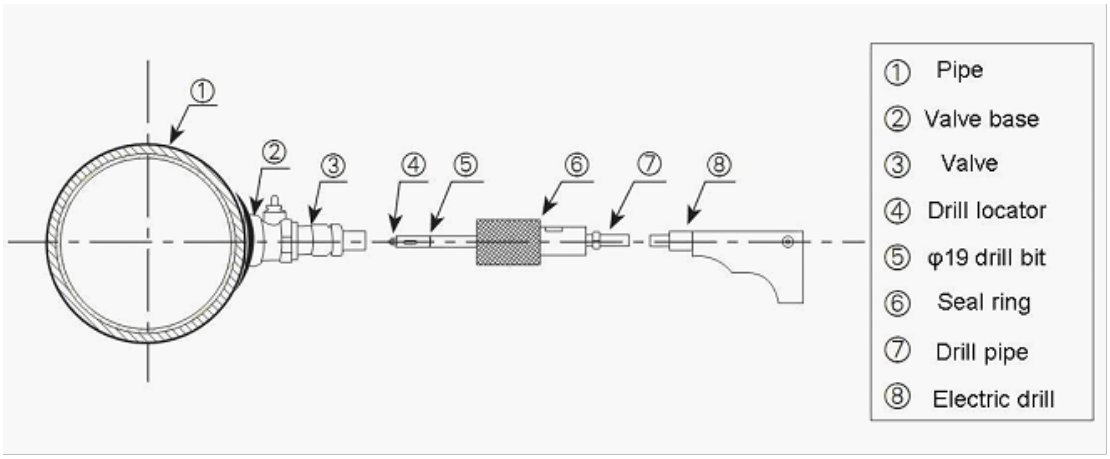
2.6.2.6 Welding the valve outlet

For the possible welding material, such as steel, stainless steel (Note: Stainless steel material should order stainless steel valve base), you just need weld the valve outlet on the pipe outside (Clean the pipe surface before welding). Keep out of gas hole otherwise it will lead to leakage or even crack.
For the impossible welding material (Such as casting iron, cement pipe) must use ordered pipe clamp (Seal with rubber pad), valve outlet welding on the pipe clamp and clamp tightly on the measured pipe. Keep the center of valve outlet overlap with point A and point B. Seal well after clamp the valve outlet tightly on the pipe outside and prevent from leakage. Wrap the seal material on the valve outlet and screw up the valve.



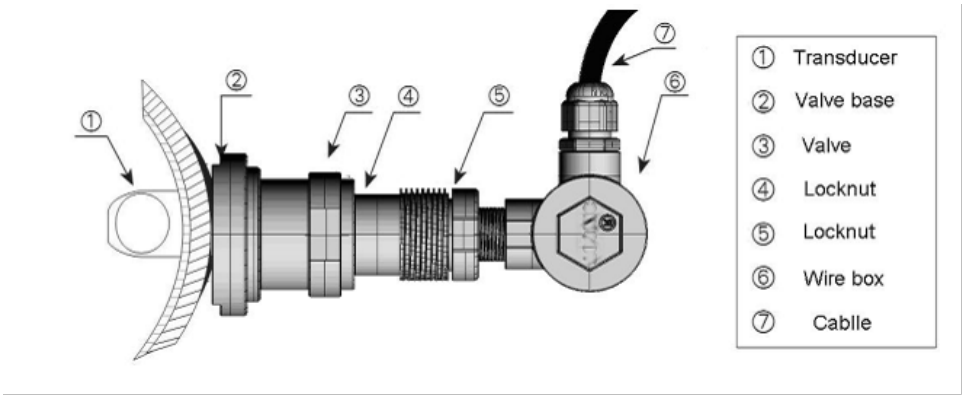
2.6.2.7 Drill hole

Connect the hole opener keeper and specific ball valve outer thread, screw tightly, open the ball valve, push the drill bar till it touch the outside of the pipe. Keep the drill and drill bar connect tightly and turn on the power to start drilling. During drilling keep the drill rotating slowly so that drill smoothly. After feel drill through, take out the drill bit till the front of the hole opener drill bit quit out to the center of ball valve and then turn off ball valve, take off the hole opener (It is better to turn on the ball valve a little and clean the bitter of iron so that convenient to the fitting of transducer)



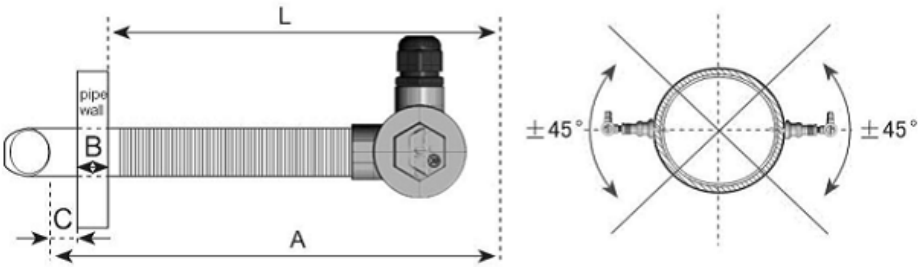
2.6.2.8 Installing transducer

Screw nut till the end of sensor, screw the transducer into the specific ball valve guider thread and when screw into the center of ball valve, open the ball valve and screw the transducer go on till the upper side of the transducer extend out of the inner side of the pipe and adjust the angle of transducer (the two transducer input line hole should up or down meantime), screw tightly the nut and finally connect the line well, seal well with the silicon seal rubber.

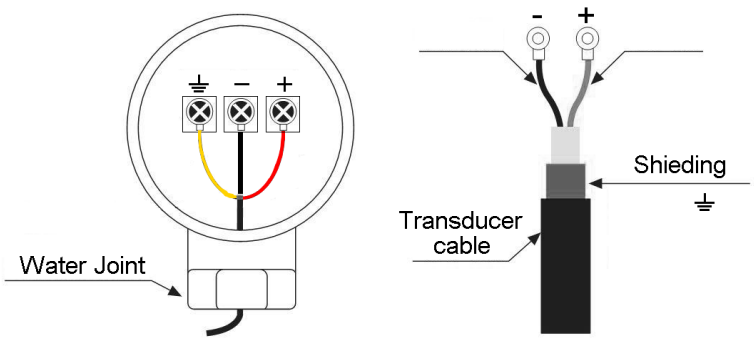


2.6.2.9 Insert lenght

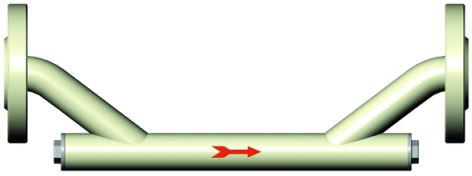
Calculate the transducer insert length into the inner pipe size.
We know transducer length A and pipe thickness B, L-the length of pipe outside can be measured too, then L=A-B and let C=0

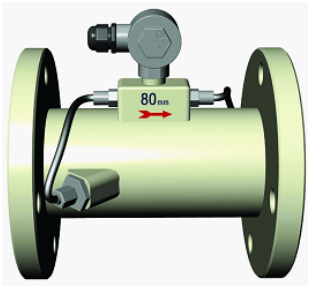


2.6.2.10 Wiring diagram



2.6.3 For Prover / pipeline transducer

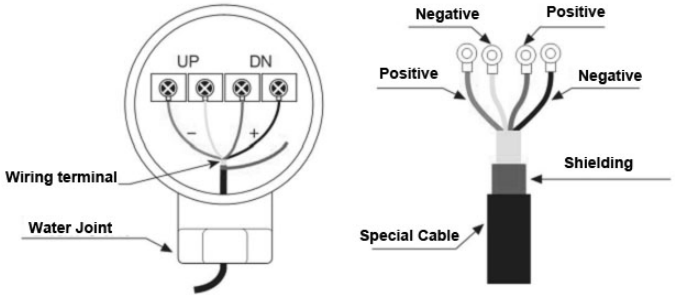




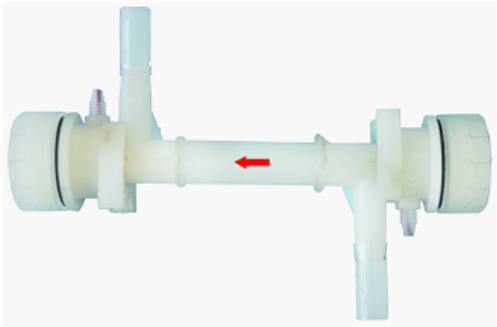
π Type Sensor (DN15--40mm) Standard **Prover sensor (**DN50--6000mm)

Prover/pipe transducer: Connection of Diameter range DN15…40mm is thread.
Connection of Diameter range DN50…6000mm is flange.

2.6.4 Wiring Connection



2.6.5 For Low flow transducer



The diameter is 6 mm at present, and the connection is insertion fitting which is connected with tube.

Wiring：

RED Wire
- Red Line + Upstream +
- White Line + Upstream –

Blue Wire
- Red Line + Downstream +
- White Line + Downstream -

2.6.6 PT100 Platinum Resistance Installation

Installation Tool:

When you install the PT100 Platinum Resistance, the hole opener, 0.8mm drill and wrench, screwdriver ect. tools should be prepared.

Installation steps:

After installation of flow transducers, thus choose a stable flow and full pipe position on the downstream of the supply pipe to install a platinum resistance, and next also choose a stable flow and full pipe position on wherever the return pipe to install ather platinum resistance.
Put and weld the base on the position where you want to install the platinum resistance, and then push the hole opener (driller) with diameter about 8mm drill bit into the center of the base until tough the surface of the pipe and then dig a hole on the pipe. Next insert the bushing into the hole, finally put carbon rod into the bushing and weld it.

2.7 Installation Checkup

Through the checkup of the installation, one can: check the receiving signal strength, the signal quality Q value, the traveling time difference of the signals, the estimated liquid speed, the measured traveling time of the signals and the calculated traveling time ratio. Therefore, optimum measurement result and longer running time of the instrument can be achieved.

2.7.1 Signal Strength

Signal strength indicates the amplitude of receiving ultrasonic signals by a 3-digit number. [00.0] means there is no signal detected and [99.9] refers to the maximum signal strength that can be received.

Although the instrument works well if the signal strength ranges from 50.0 to 99.9, stronger signal strength should be pursued, because a stronger signal means a better result.

The following methods are recommended to obtain stronger signals:

(1) Relocate a more favorable location, if the current location is not good enough for a stable and reliable flow reading, or if the signal strength is **lower than 60.0**.
(2) Try to polish the outer surface of the pipe, and apply more coupler to increase the signal strength.
(3) Adjust the transducers both vertically and horizontally while checking the varying signal strength, stop at the highest position, and then check the transducers spacing to make sure the transducers spacing is the same as what the **M25** shows.

2.7.2 Signal quality

Signal quality is indicated as the Q value in the instrument. A higher Q value would mean a higher Signal and Noise Ratio (short for SNR), and accordingly a higher degree of accuracy would be achieved. Under normal pipe condition, the Q value is in the range 60.0-90.0, the higher the better.

Causes for a lower Q value could be:

(1) Interference of other instruments and devices such as a powerful transverter working nearby. Try to relocate the flow meter to a new place where the interference can be reduced.
(2) Bad sonic coupling for the transducers with the pipe. Try to apply more coupler or clean the surface, etc.
(3) Pipes are difficult to be measured. Relocation is recommended.

2.7.3 Time Ratio between the Measured Total Transit Time and the Calculated Time

This ratio would be used to check the transducer installation. If the pipe parameters are entered correctly and the transducers are installed properly, the value for this ratio should be in the range of 100±3.

If this range is exceeded, the user should check:

(1) If the pipe parameters are correctly entered.
(2) If the actual spacing of the transducers is right and the same as what the window M25 shows.
(3) If the transducers are installed properly in the right directions.
(4) If the mounting location is good and if the pipe has changed shape or if there is too much fouling inside the pipes.
(5) Other poor condition.

3 Menu Window Details

3.1 Menu Windows Arrangement

M00~M09 Windows for the display of the flow rate, velocity, date time, totalizers, battery voltage and estimated working hours for the battery.
M10~M29 Windows for entering the pipe parameter.
M30~M38 Windows for flow rate unit selections and totalizer unit selections.
M40~M49 Windows for response time, zeroing, calibration and modification password setup.
M50~M53 Windows for the built-in logger
M60-M78 Windows for time-keeper initialization, version and ESN Information viewing and alarms.
M82 Window for viewing date totalizer.
M90~M94 Are diagnostic windows for a more accurate measurement.
M97~M99 Are not windows but commands for the outputting of display copying and pipe parameter setups.
M+0~M+8 Are windows for some additional functions, including a scientific calculator, viewer on records such as total working hours, turn-on and turn-off times, dates and times when the flow meter has been turned on or turned off.

Other menu windows such as M88 have no functions, or functions were cancelled because they are not applied to this version of the software.

The major reason why the menu windows are arranged in this way is that the software programmer hopes that the menu window arrangement for this version can be compatibility with the previous versions of the flow meter software. This will make it easier for the former version users with this flow meter series.

3.2 Menu Window Details

Menu window No.	Function
M00	Display flow rate and net totalizers
M01	Display flow rate, velocity
M02	Display date time and positive totalizer
M03	Display flow rate and net totalizer
M04	Display date and time, flow rate
M05	Display total energy and energy rate
M06	Display temperatures, T1, T2
M07	Display analogue inputs, converted value and current value for AI3, AI4
M08	Display all the detailed working status
M09	Display today's total flow
M10	Window for entering the outer perimeter of the pipe
M11	Window for entering the outer diameter of the pipe
M12	Window for entering pipe wall thickness
M13	Window for entering the inner diameter of the pipe
M14	Window for selecting pipe material Standard pipe materials (that the user need not know the speed) include: (0) carbon steel (1) stainless steel (2) cast iron (3) ductile iron (4) copper (5) PVC (6) aluminum (7) asbestos (8) fiberglass
M16	Window for selecting the liner material, select none for pipes without any liner Standard liner materials that the user need not know the speed include: (1) Tar Epoxy (2) Rubber (3) Mortar (4) Polypropylene (5) Polystryol (6)Polystyrene (7) Polyester (8) Polyethylene (9) Ebonite (10) Teflon
M18	Window for entering the liner thickness, if there is a liner
M19	Window for entering the ABS thickness of the inside wall of the pipe
M20	Window for selecting fluid type For standard liquids that the user need not know the liquid speed include: (0) Water (1) Sea Water (2) Kerosene (3) Gasoline (4) Fuel oil (5) Crude Oil (6) Propane at -45C (7) Butane at 0C (8)Other liquids (9) Diesel Oil (10)Caster Oil (11)Peanut Oil (12) #90 Gasoline (13) #93 Gasoline (14) Alcohol (15) Hot water at 125C

M23	Window for selecting the proper transducers There are 23 different types of transducers for selection. If the user-type-transducers is selected, system will prompt another 4 user –type-wedge parameters to be input, If the PI-type transducer is selected, the system needs also another 4 PI type transducer parameters Common use : 8.Standard HS (for Small rack transducer) 9.Standard HM (for Medium rack transducer) 10.Standard- M1 (for high-temp Medium transducer) 11.Standard- S1 (for high-temp Small transducer) 10.Standard- L1 (for high-temp Large transducer) 13.PI – type (for Prover/pipeline transducer & Low flow transducer) 16.Clamp-on TM-1 (for clamp-on Medium transducer) 17.Inserction TC-1 (for standard Insertion transducer) 18.Clamp-on TS-1 (for clamp-on Small transducer) 20.Clamp-on TL-1 (for clamp-on Large transducer) 21.Inserction TLC-1 (for large Insertion transducer)
M24	Window for selecting the transducer mounting methods Four methods can be selected: (0) V-method (1) Z-method (2) N-method (3) W-method
M25	Display the transducer mounting spacing
M26	(1) A switch for the parameters in flash memory will be loaded when power is turned on. The default option is that the parameters will be loaded. If this switch is not turned on, the system will try to use the parameters in the system RAM, if these parameters are ok or the system will load the parameters in flash memory. (2) Function to store the current parameters into the flash memory
M27	Entry to store to or restore from the internal Flash memory, as many as 9 different pipe parameter configurations
M28	Select YES or NO for the instrument to determine whether or not to hold (or to keep) the last correct value when poor signal condition occurs. YES is the default setup
M29	Pipe empty setup. Enter a value ranging from 00 to 99 is the default value. The flow rate will be set to 0 if the signal strength is below the entered value.
M30	Window for selecting unit system. Default value is ‘Metric’. The change from English to Metric or vice versa will not affect the unit for totalizers.

M31	Window for selecting flow rate that will be used by the instrument afterward. Flow rate can be in: 0. Cubic meter (m^3) 1. Liter (l) 2. USA gallon (gal) 3. Imperial Gallon (igl) 4. Million USA gallon (mgl) 5. Cubic feet (cf) 6. USA liquid barre (bal) 7. Oil barrel (ob) The flow unit in terms of time can be per day, per hour, per minute or per second. So there are 32 different flow rate units in total for selection.
M32	Window for selecting the totaliziers' working unit
M33	Select totalizer multiplier The multiplier ranges from 0.001 to 10000
M34	Turn on or turn off the NET totalizer
M35	Turn on or turn off the POS totalizer
M36	Turn on or turn off the NEG totalizer
M37	(1) Totalizer reset (2) Restore the instrument to the default parameters as the manufacturer did by pressing the dot key followed by the backspace key. *- Take care or make note on the parameters before doing the restoration*
M38	Press-a-key-to-run or to stop totalizer for easier calibration
M39	Interface language selection: The selection could also be changed automatically by the system, if English LCD display are used as the display device.
M3A	Setup for local segmental LCD display. - Enter 0 or 1 for the non-auto-scan mode - Enter 2-39 for the auto-scan mode, in which mode the display will automatically scan displaying from 00 to the entered number of the local segmental LCD display
M40	Flow rate damper for a stable value. The input range is 0 to 999 seconds. 0 means there is no damping. Default value is 10 seconds
M41	Lower flow rate cut-off to avoid invalid accumulation.
M42	Zero point setup under the condition when there is no liquid running inside the pipe.
M43	Clear the zero point set by the user, and restore the zero point set by the manufacturer

M44	Set up a manual flow bias. Generally this value should be 0.
M45	Scale factor for the instrument. The default value is '1'. Keep this value as '1', when no user calibration has been made.
M46	Network environment Identification Number. Any integer can be entered except 13(0DH, carriage return), 10 (0AH, line feeding), 42 (2AH), 38, 65535. Every set of the instrument in a network environment should have a unique IDN. Please refer to the chapter for communication.
M47	System locker to avoid modification of the parameters
M48	Entry to linearity correct data inputs. There are as many as 12 point-data can be input
M49	Displays the input contents for the serial port.
M50	Switches for the built-in data logger. There are as many as 22 different items can be chosen.
M51	Time setup for the data logger/Thermo-printer
M52	(1) Data logging direction control. If 'Send to RS485' is selected, all the data produced by the data logger will be transmitted out through the RS-232/RS485 interface (2) If 'To the internal serial BUS' is selected, the data will be transmitted to the internal serial bus which allows thermal printer, 4-20mA analog output module
M53	Display the converted value and current value for analog input AI5
M54	Pulse width setup for the OCT (OCT1) output
M55	Analog output mode selection. 9 modes to be chosen
M56	Setup for the value via 0mA or 4mA of the analog output
M57	Setup for the value via 20mA of the analog output
M58	Analog output checkup
M59	Current outputted from the analog output
M60	Calendar. Press ENT for modification. Use the dot key to skip the digits that need no adjusting
M61	Display Version information and Electronic Serial Number (ESN) that are unique for each TF-100W series flow meter. The users can employ the ESN for instrumentation management
M62	RS-232 RS485 setup. Baud rate can be 300 to 19200 bps
M63	Communication protocol selection. Default is for protocols which have ASCII format, such as MODBUS-ASCII, Meter-BUS, Fuji extended protocol, huizhong's various protocols. The other select is for MODBUS_RTU
M64	AI3 value range inputs, two values which are presented by the 4mA and 20mA current should be inputted
M65	AI4 value range inputs
M66	AI5 value range inputs
M67	Input the frequency range for the frequency output. The biggest range is 0Hz-9999Hz. Default value is 1-1000 Hz
M68	Enter a flow rate value that corresponds to lower frequency
M69	Enter a flow Rate value that corresponds to higher frequency
M70	LCD display backlight control. The entered value indicates how many seconds the backlight will be on with every key pressing
M71	LCD contrast control. The LCD will become darker or brighter when a value is entered

M72	Working timer. It can be cleared by pressing ENT key, and then select YES
M73	Enter Lower Flow Rate value that will trigger the #1 Alarm. There are two virtual alarms in the system. By “virtual” we mean that the user must redirect the output of the alarms by setup the output hardware in M78 and M77
M74	Enter the higher flow rate value that will trigger the #1 Alarm.
M75	Enter the lower flow rate value that will trigger the #2 Alarm.
M76	Enter the higher flow rate value that will trigger the #2 Alarm.
M77	Buzzer setup. If a proper input source is selected, the buzzer will beep when the trigger event occurs
M78	OCT (Open Collect Transistor Output) setup By selecting a proper input source, the OCT hardware will close when the trigger event occurs
M79	Relay or OCT2 setup By selecting a proper input source, the hardware will close when the trigger event occurs Note. In order to make the user interface compatible with the future product, the name RELAY was used other than OCT2, but in fact it is an OCT output
M80	Signal selection for the built-in batch controller
M81	The built-in batch controller
M82	Date totalizer by day, by month and by year
M83	Automatic total flow correction switch
M84	Energy unit select
M85	Temperature select
M86	Specific Heat select
M87	Energy totalizer switch
M88	Energy totalizer switch
M89	1. Display the temperature difference 2. The window to set the lowest temperature difference
M90	Display signal strength and signal quality (Q value), Signal strength is presented by 00.0 to 99.9, the bigger the value, the bigger the signal strength will be, and more reliable readings will be made. Q value is presented by 00 to 99, the bigger the better. It should at least be great than 50 for normal operations
M91	Displays the Time Ratio between the Measured Total Transit Time and the Calculated time. If the pipe parameters are entered correctly and the transducers are properly installed, the ratio value should be in the range of 100±3%. Otherwise the entered parameters and the transducer installation should be checked.
M92	Displays the estimated fluid sound velocity. If this value has an obvious difference with the actual fluid sound speed, pipe parameters entered and the transducer installation should be checked again.
M93	Displays total transit time and delta time (Transit time difference)
M94	Displays the Reynolds number and the pipe factor used by the flow rate program.
M95	1. Display the positive and negative energy totalizers Entry to start the loop-displaying windows from M00----M08 to M90---M95. The loop-displaying will stop when any key pressed

M96	Command for the thermal printer to advance 5 lines of paper
M97	Command to print the pipe parameters entered by the user. The printing data can be directed either to the internal serial bus or to RS-232 serial interface
M98	Command to print the diagnostic information. The printing data can be directed either to the internal serial bus or to RS-232C serial interface
M99	Command to copy the current display. The printing data can be directed either to the internal serial bus or to RS-232C serial interface
M+0	Browse the 32 recorded instrument power-on and power-off date and time with the flow rate at the time of power on and off
M+1	Displays the total working time of the instrument
M+2	Displays the last power-off date and time
M+3	Displays the last power-off flow rate
M+4	Displays how many times of instrument has been powered on
M+5	A scientific calculator for the convenience of field working. All the values are in single accuracy
M+6	Enter a number as the velocity of the liquid for the system to determine if another kind of liquid is running.
M+7	Displays total flow for this month (only for the time past)
M+8	Displays total flow for this year (only for the time past)
M+9	Not working total time in seconds. It include the time when power off, if the back-up battery is applied
M.2	Entry to solidify the zero point. Password protected
M.5	Setup the Q value threshold. If Q is below this threshold, flow rate will be set to 0
M.8	The maximum flow rates for today and this month
M.9	Serial port tester with CMM command output for every second.
M-0	Entry to hardware adjusting windows only for the manufacturer
M-1	4-20mA output adjustment
M-2	4mA calibration for AI3 input
M-3	20mA calibration for AI3 input
M-4	4mA calibration for AI4 input
M-5	20mA calibration for AI4 input
M-6	4mA calibration for AI5 input
M-7	20mA calibration for AI5 input
M-8	Lower temperature zero setup for the PT100
M-9	Higher temperature zero setup for the PT100
M-A	Temperature calibration at 50 ^{o}C
M-B	Temperature calibration at 84.5 ^{o}C

Note: 1. Windows in Red are new to our older version of flow meter
2. Windows in blue are energy related windows
3. The term totalizer is also called accumulator

4 How to…

4.1 How to judge if the instrument works properly

Enter into M08, if '**R**' is displayed on the screen, the instrument is working properly,

If '**E**' is displayed, the current loop output is over-ranged. Increasing the range setting in M57 will make the '**E**' letter disappear. If you do not use current loop output, you may ignore this error.

If '**Q**' is displayed, the frequency output is over-ranged. Increasing the range setting in M69 will make the '**Q**' letter disappear. If you do not use frequency output, you may ignore this error.

If an '**H**' flashes on that place, there could be poor signal received. Please refer to the chapters on diagnosis.

If '**G**' is displayed, the flow meter is adjusting system gain. This is normal as far as it does not last long time.

If an '**I**' is displayed, it means that there is no signal detected.

If '**J**' is displayed, there is hardware problem. Turn off the power, then, turn on the power again. If the problem remains, refer to Chapter 5 for diagnosis details.

4.2 How to judge the liquid flowing direction

(1) Make sure that the instrument works properly

(2) Check the flow rate for the indication. If the displayed value is POSITIVE, the direction of the flow will be from the RED transducers to the BLUE transducers; if the displayed value is NEGATIVE, the direction will be from the BLUE transducers to the RED transducers.

4.3 How to change between units systems

Use menu window M30 for the selection of unit system in English or Metric system.

4.4 How to select a required flow rate unit

Use menu window M31 to select the flow unit first and then the timing unit.

4.5 How to use the totalizer Multiple factor

Use window M33 to select a proper totalizer. Make sure that the totalizer pulse is appropriately speeded. It should not be too fast and neither too slow. A speed of producing a pulse in several seconds or minutes is preferable.

If the totalizer multiplier is too small, there can be a loss of accumulation pulse because the output device can output only one pulse in a measurement period (500milliseconds)

If the totalizer multiplier is too large, the output pulse will be too fewer for the devices that are connected with the instrument for a quicker response.

4.6 How to open or shut the totalizers

Use M34, M35 and M36 to turn on or turn off the POS, NEG, or NET totalizer respectively.

4.7 How to reset the totalizers

Use M37 to reset the proper totalizer.

4.8 How to restore the flow meter with default setups

Use M37, when the 'selection' message is displayed. Press the dot key first and the message 'Master Erase' will display, then press the backspace key ◄
The master erase step will erase all the parameters entered by the user and setup the instrument with default values without "instrument factor" and "network identification number" parameter

4.9 How to use the damper

The damper acts as a filter for a stable reading. If '0' is entered in window M40, that means there is no damping. A bigger number brings a more stable effect. But bigger damper numbers will prevent the instrument from acting quickly.

Numbers 0 to 30 are commonly used for the damper value. Default value is 10 seconds.

4.10 How to use the zero-cutoff function

The number displayed in window M41 is called the lower flow rate cut-off value. The flow meter will replace these flow rate values that are absolutely less than the low-cutoff value with '0'. This means the flow meter will avoid any invalid accumulation when the actual flow is below the zero-cutoff value. Generally the default value is 0.03m/s.

The low-cutoff value does not affect the flow measurement when the actual flow is absolutely greater than the low-cutoff value.

4.11 How to setup a zero point

There exists a 'Zero Point' with certain installation which means the flow meter will display a non-zero value when the flow is absolutely stopped. In this case, setting a zero point with the function in window M42 will bring a more accurate measurement result.

Make sure that there is no liquid running inside the pipe, then run the function in window M42 by pressing the ENT key.

4.12 How to get a scale factor for calibration

A scale factor is the ratio between the 'actual flow rate' and the indicated value by the flow meter.
It can be determined by calibration with standard flow calibration equipment. You may change the scale factor in menu window M45.
The scale factor can be determined by calibration with flow calibration equipment.

4.13 How to use the system locker

The system locker provides a means of preventing inadvertent configuration changes or totalizer resets.

When the system is locked, menu window browsing can be done without affecting any change, but any modifications are prohibited.

The system can be locked without a password or with a 1 to 4 digit password. With a no-password locking, directly press the ENT key in M47

If the password is forgotten, please contact the factory.

4.14 How to use fixed time data output function

TF-100W Series Ultrasonic flow meter can output data to RS232 communication port, so that fixed time data output can be set up.
Fixed time data output can set up output content, start time, interval time and continuance time.
In menu M50 to input the option for output content. Firstly choose "ON", then select output content in order (22 items in all), if output the content is what you want, after pressing ENT key, select "ON", if not, select "OFF".
Checking M51 to input output time. Regarding M50 & M51 of "Menu details " for reference.

4.15 How to use 4-20mA current loop output

The accuracy of the current loop output is better than 0.1%. It can be configured to different mode, such as 4-20mA mode, 0-20mA etc. Mode selection can be made in menu M55. Refer to the next chapter for details on M55.

In order to use the 4-20mA output function, you need not only select the mode to be 4-20mA in M55, but also set the flow rate values which correspond to the minimum current (4mA) and the maximum current (20mA). Enter the two values in M56 and M57.

Example A:
Flow rate range is 0-500m^3/h. Just enter 0 in M56 and 500 in M57.

Example B:
Flow rate range is -500-0-1000m^3/h. If flow direction is not an issue for you, you may select 20-4-20mA mode in M55. Then, enter 500 in M56 and 1000 in M57. If flow direction is an issue, you may select 0-4-20mA mode in M55. This means that the current loop will output 0-4mA when flow rate is negative and 4-20mA when flow rate is positive. Enter -500 in M56 and 1000 in M57.

You may need to calibrate and test the current loop output before using it. Just go to menu M58 and do the following:

First, connect an ammeter to the current loop output.

Press MENU 5 8, then ENT to enter into menu M58.

Use ▲/+ and ▼/- to display "0mA", "4mA", "8mA", "16mA", "20mA" orderly, record the corresponding reading on the ammeter. Calculate the differences between the readings and the selected ones. For instance, when 4mA is selected, the actual output current shown on the ammeter is 4.01mA. Then, the difference is 0.01mA.

If the differences are not within tolerance, calibrate the current loop

The present current loop output is displayed in Window M59. It changes along with flow rate change.

4.16 How to use the Analog voltage Output

There are two ports (21, 22 port) on the current loop output which is paralleling connected with a 250 resistance,so that convert 4-20mA to 1--5V analog voltage output.

4.17 How to use the Frequency Output

There is a Frequency Output in all TF-100W series flow meters. This frequency output signal, which represents the flow rate, is intended to connect with other instruments.

The Frequency Output is totally user-configurable. Generally, four parameters should be configured for the setups.

Enter the lower flow rate value in window M68 and the higher flow rate value in window M69.

Enter the frequency range in window M67.

For example, assume that the flow rate varies in a range 0m^3/h to 3000m^3/h, and an output signal is at a maximum frequency of 1000Hz, the minimum of 200Hz is going to be required for other instrumentation. The user should enter 0 in M68 and 3000 in M69, and enter 200 and 1000 in window M67.

Please note that the user has to make the selection with OCT setups in window M78 .

4.18 How to use the Totalizer Pulse Output

The totalizer output will produce a pulse output with every unit flow of the totalizer.

The totalizer pulse output can only be realized by mapping the pulse output to the OCT or BUZZER hardware devices.

For example, assume that the POS totalizer pulse output is needed, and every pulse should represent 0.1cubic meter of liquid flow; the pulse output will be mapped to the internal Buzzer, so that with every 0.1 cubic meter of flow the BUZZER will beep for a while.

The following setups should be taken/performed:
(1) Select the unit Cubic Meter under window M32.
(2) Select the Multiplier as '2. 0X0.1' under window M33.
(3) Select the output option '9. POS INT Pulse' under window M77. (INT stands for totalized)

4.19 How to produce an alarm signal

There are 2 types of hardware alarm signals that are available with this instrument. One is the Buzzer, and the other is the OCT output.

Both for the Buzzer and OCT output the triggering sources of the event include the following:
(1) There is no receiving signal
(2) There is poor signal received.
(3) The flow meter is not in normal measurement modes.
(4) Reverse flow.
(5) Overflow occurs at the analogue output by 100% or more
(6) Overflow occurs at the frequency output by 120% or more.
(7) The flow rate is out of the specified range which is configured in windows M73 and M74 for Alarm #1, and in windows M75 and M76 for Alarm #2.

Example A:
Assume we need the Buzzer to start beeping when the flow meter is not ready in normal measurement. Switch to M77, select item "2. Abnormal Measurement State"

Example B:
Assume we need the Buzzer to start beeping when the flow rate is less than 300 m^3/h and greater than 1000m^3/h. The following setup steps would be recommended:

(1) Enter flow rate lower limit 300 in M73 for #1 alarm.
(2) Enter flow rate upper limit 1000 in M74 for #1 alarm.
(3) Select item '6. Alarm #1' in M77.

Example C:
Assume we need the OCT output to activate when flow rate exceeds 100~500m^3/h and the relay output to activate when flow rate exceeds 600~1000m3/h. The following setup steps would be recommended:

(1) Enter flow rate lower limit 100 in M73.
(2) Enter flow rate upper limit 500 in M74.
(3) Enter flow rate lower limit 600 in M75.
(4) Enter flow rate lower limit 1000 in M76.
(5) Select item '6. Alarm #1' in M78.
(6) Select item '6. Alarm #1' in M79.

4.20 How to use the built-in Buzzer

The built-in buzzer is user-configurable. It can be used as an alarm. Use M77 for setups.

4.21 How to use the OCT output

The OCT output is user-configurable, which can be performed by selecting the proper input source such as pulse output. Use M78 for the setups.
Please make sure that the Frequency Output shares the OCT.

The OCT output shares pins with the RS-232C interface, and the terminal is at Pin 1 and 8

4.22 How to use relay output

The relay output of TF-100W series is programmable, the user can set up one of turn on /off condition as follows: System alarm signal or totalizer pulse output ect.
Regarding M79 in window.

4.23 How to modify time

Time should not be modified generally. Because TF-100W adopts perpetual calendar clock chip which produced by RAMTRON, and it is high reliability. Modification will be required only in such cases as when the battery is totally consumed, or when the changing of the battery takes a long time.
In case of needing modification, go to window Menu 60, press [ENT] and then showing a ">" on the left of the screen indicating that have on the modification situation, while using [.] to jump over the number which do not to be modified, and then press [ENT] to confirm.

4.24 How to adjust LCD display screen.

The backlight and contrast of TF-100W LCD display screen control is available by window.Go to the M70 to control the backlight. Press [MENU] [7] [0], and next press [ENT] then there is a ">" on the left of the screen indicating that have on the modification situation, while input backlight number.
Go to Menu M71 to control the contrast of LCD display screen. When the digit is not clear or the angle of view is wrong, it is necessary to modify the contrast. Press [MENU] [7] [1], and next press [ENT] then there is a ">" on the left of the screen indicating that have on the modification situation, while press [▲/+] and [▼/-] to decrease or increase the value.

4.25 How to use RS232/RS485 interface

There are both RS232 standard DB9 serial interface and RS485 interface, the data speed is optional range from 75 to 115200 baud.
Go to window M62 to set up the parameters of serial interface, the baud rate and parity bit are available.
Adopting a compatible RS232 to RS485 converter is convenient to let the flow meter connected with RS485 Bus. This converter should be electric isolation in order to used in industrial surroundings.

4.26 How to check the flow of everyday, every month, every year

Go to window M82 to check the historical flow data and working situation on last 64 days. Press [MENU] [8] [2], and next select 0 item "based on day",while showing "00"-"63" on the left indicate the serial number ; In the middle "00-07-21" indicate date, "-----" on the top right corner indicate working situation, if in this area only showing "-----" indicate it is working well. If showing other characters, please refer to the wrong characters explain.
The value on the bottom is net total flow in the whole day.
Checking month flow, please press [MENU] [8] [2],and next select 1 item "based on month".
Checking month flow, please press [MENU] [8] [2],and next select 2 item "based on year".

4.27 How to make up flow automatically after the power supply was turned off

Go to window M83 to select "ON", thus the flow could be made up automatically when the power supply is turned on. Select "OFF" to cancel this function.

This function is limited by many conditions, so user should make sure the power supply continual.

4.28 How to use the Working Timer

Use the working timer to check the time that has passed with a certain kind of operation. For example, use it as a timer to show how long a fully-charged battery will last.

Under M72, press ENT key and then select YES to reset the timer.

4.29 How to use the manual totalizer

Use M38 for the manual totalizer. Press ENT key to start and stop the totalizer.

4.30 How to know how long the battery will last

Use M07 to check how long the battery will last. Also please refer to §.2.1

4.31 How to check the ESN and other minor details

Every set of the TF-100W flow meter utilizes a unique ESN to identify the meter. The ESN is an 8-digit number that provides the information of version and manufacturing date.

The user can also employ the ESN for instrumentation management.

The ESN is displayed in window M61.

Other details about the instrument are the total working hours displayed in window M+1, and the total power-on times displayed in window M+4.

5 Calorie/heat and other physical measurements

5.1 Calorie measurement summary

TF-100W has two-road 3-wire PT100 standard temperature measuring interface, which can measure temperature range from -40 to 160 degree celcius. After calibration, the error less than 0.1% during 0---150 degree celcius.
The temperature signal could be inputed by AI3, AI4 port of TF-100W series ultrasonic calorimeter/heat meter.

5.2 PT100 resistance connection

Connect the earth wire of the two PT100 resistances to port 66 as a common ground, which there is a label "GND" on the circuit board.
The power supply port and signal port of liquid supply loop temperature transducer /sensor should be connected with TX1 and T1on the right of circuit board respectively.The power supply port and signal port of liquid return loop temperature transducer/sensor should be connected with TX2, T2 respectively.

Note: The temperature measurement and flow measurement share a same earth wire.

5.3 Menu details about temperature measurement

M84 select the unit of temperature measurement.

M85 select temperature signal input source: from T1, T2 or from AI3, AI4 (T1, T2 is acquiescence).

M87 switch of calorie totalizer.

M88 set **totalizer** Multiple factor, it means define totalizer range.

M89 Display temperature difference and also set the sentience of temperature difference when temperature totalizing. Setting a proper sentience of temperature value to make sure the totalizer should not totalizing when it is in a very lower temperature difference. The low sentience of temperature value is 0.1 degree celcius seted by factory.

M06 Display current T1,T2 two-road input temperature value and other valid resistance value.

M95 Display current positive and negative calorie totalizer content.

M-8, M-9, M-A, M-8 four menu are used on temperature measurement calibration.

5.4 About temperature measurement value output

Instantaneous heat flow output by 4-20mA electric current loop.
In the Menu M55, select "8. 4-20mA corresponding heat flow" means electric current loop output value represent Instantaneous heat flow.
Next in the Menu M56 input corresponding heat flow value of 4 mA .

For example, there is a case, the range of Instantaneous heat flow is 0---1000GJ/h, TF-100W connected with DCS control system which is using 4…20mA signal input, requiring when instantaneous heat flow = 0, electric current loop output = 4 mA, when Instantaneous heat flow =1000GJ/h, electric current loop output = 20 mA, thus three steps as follows to achieve the goal:

A. In M55 to select "8. 4…20mA corresponding heat flow".
B. In M56 input 0 value.
C. In M57 input 1000.

The following value is available for printer /fixed time data output:

1. Instantaneous heat flow.
2. Positive total calorie.
3. Negative total calorie.
4. Net total calorie.
5. T1 temperature.
6. T2 temperature.
7. Analog Input AI3, AI4.

About M50, M51, M52 setup:

For example, requiring output Instantaneous calorie, positive total calorie, T1 temperature value on fixed time from serial port every second.

Three steps as follows:
A.In M50 to select Instantaneous calorie,positive total calorie ,T1 temperature value items.
B.In M51 to input start time**.**.** interval time is 00:00:01, print time is 8000.
C.In M52 to select "1.output to serial port".

Total calorie pulse output setup:

Total calorie pulse output could be seted from OCT or RELAY to external device.In the corresponding items of OCT or relay output select corresponding total pulse, thus can finish this function.

For example supposing require output positive total calorie pulse from OCT, the Instantaneous flow is about 1 GJ per second, thus select output item "12.positive total calorie pulse" in M78. At that time, there is close on the OCT output port at every second.
Pay attention that the OCT electrocircuit made way by collector, so that it have not voltage signal or electric current output, which is necessary connected with power supply and resistance normally.

6 Trouble analysis

TF-100W ultrasonic flow meter/calorimeter designed with complete automatic diagnosis.
The code will showing on the top right corner of the LCD on time order.
Menu M08 can show all the existed trouble according to priority.

If troubles are found when flow meter power on, there is "F" on the top left corner after on the measuring situation. Thus please turn on the flow meter again and check all display information, and follow the steps below.

Form 1: Power-on automatic diagnosis information, reasons and resolution.

LCD display Info.	**Reasons**	**Resolution**
Procedure ROM calibration summation incorrect	ROM system illegal or incorrect	Contact factory
Incorrect reading of data storage	Incorrect data on Internal storage	Restart/Contact factory
Incorrect of System data storage		Restart/Contact factory